NRC Research to Support Regulatory Decisions Related to Subsequent License Renewal Periods

C. E. (Gene) Carpenter, Jr.
Group Lead for Aging Management Issues
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Gene.Carpenter@nrc.gov

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Outline

- Why Long-Term Operation
- NRC Aging Management Research
- Conclusions/Path Forward

Why Long-Term Operation

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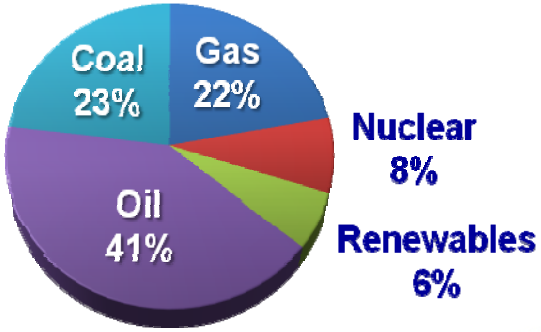
- EIA 2008 Annual Energy Outlook
  - Projects **30 - 50%** increase (1,150 TW-hr) in U.S. electricity consumption by 2030.
  - New load addition equivalent to 2006 consumption of California, Florida, Ohio, Pennsylvania, and Texas
  - Equivalent to 46 new 1,000-MW power plants

U.S. Energy Demand 2006

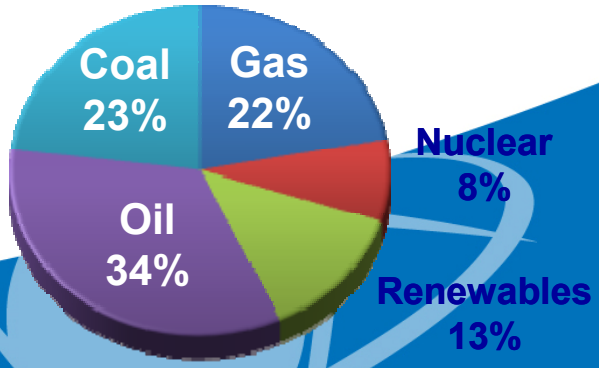
100 QBtu / Year
85% Fossil Energy



+ 11%

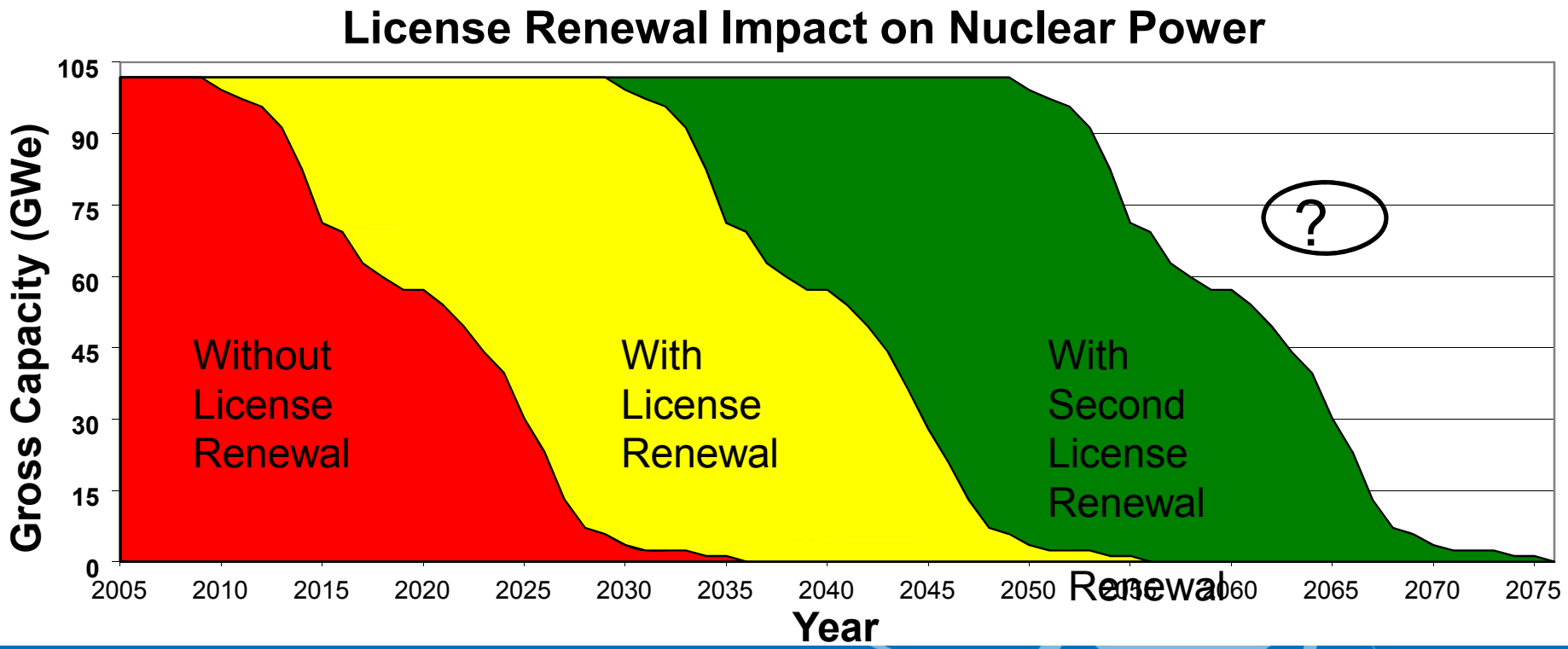
U.S. Energy Demand 2030

111 QBtu / Year
78% Fossil Energy



Why Long-Term Operation

- Steep fall-off in generating capacity if current nuclear operations not sustained
  - 5% total U.S. generating capacity lost by 2035; 15% by 2045
  - These shutdowns would not be for technical or economic issues, but from a failure to prepare for extended operations of safe, clean and secure energy supply



Age of US NPPs

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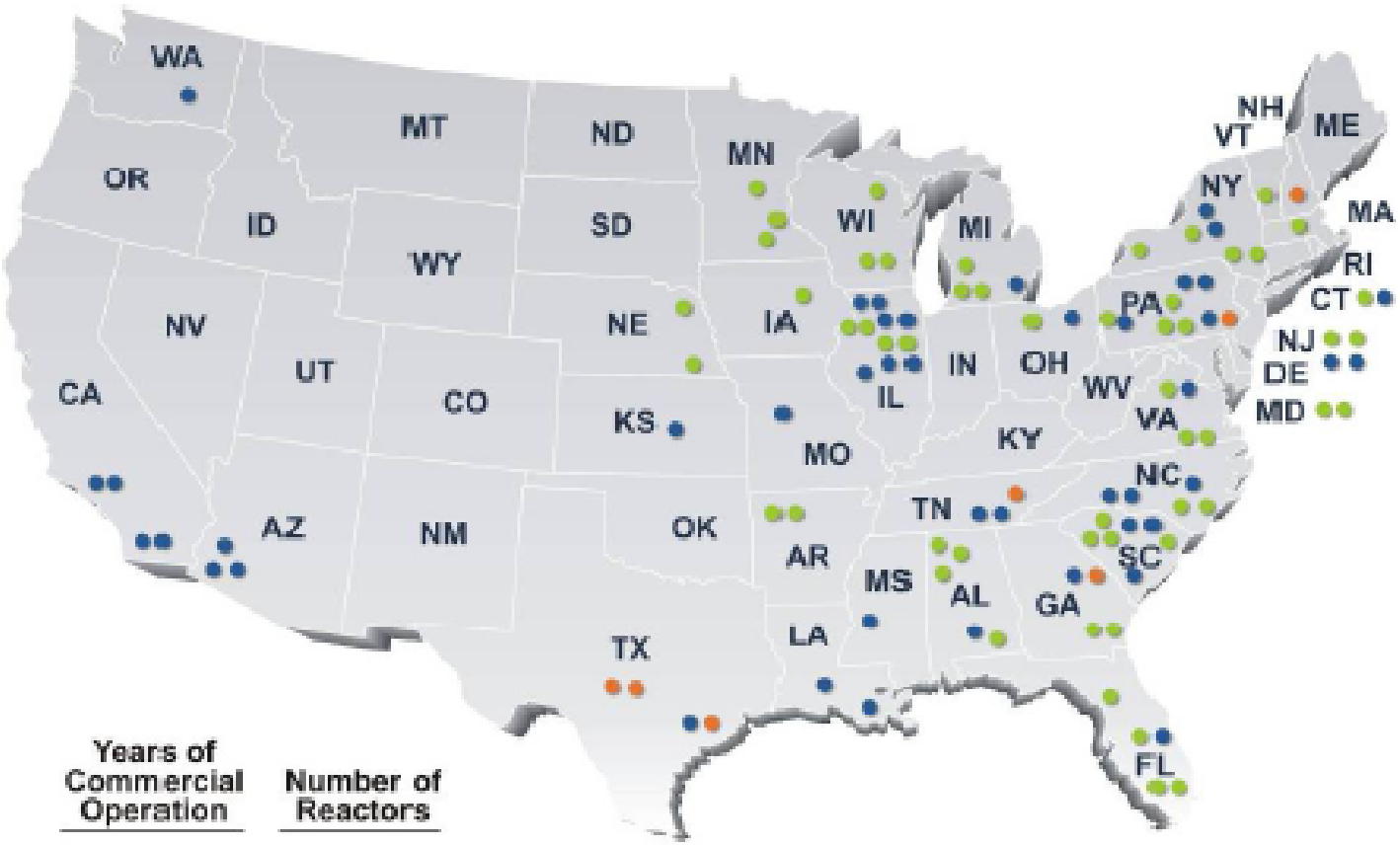

Years of Commercial Operation	Number of Reactors
10-19	7
20-29	44
30-39	53

Note: There are no commercial reactors in Alaska or Hawaii.

Global Age of NPPs

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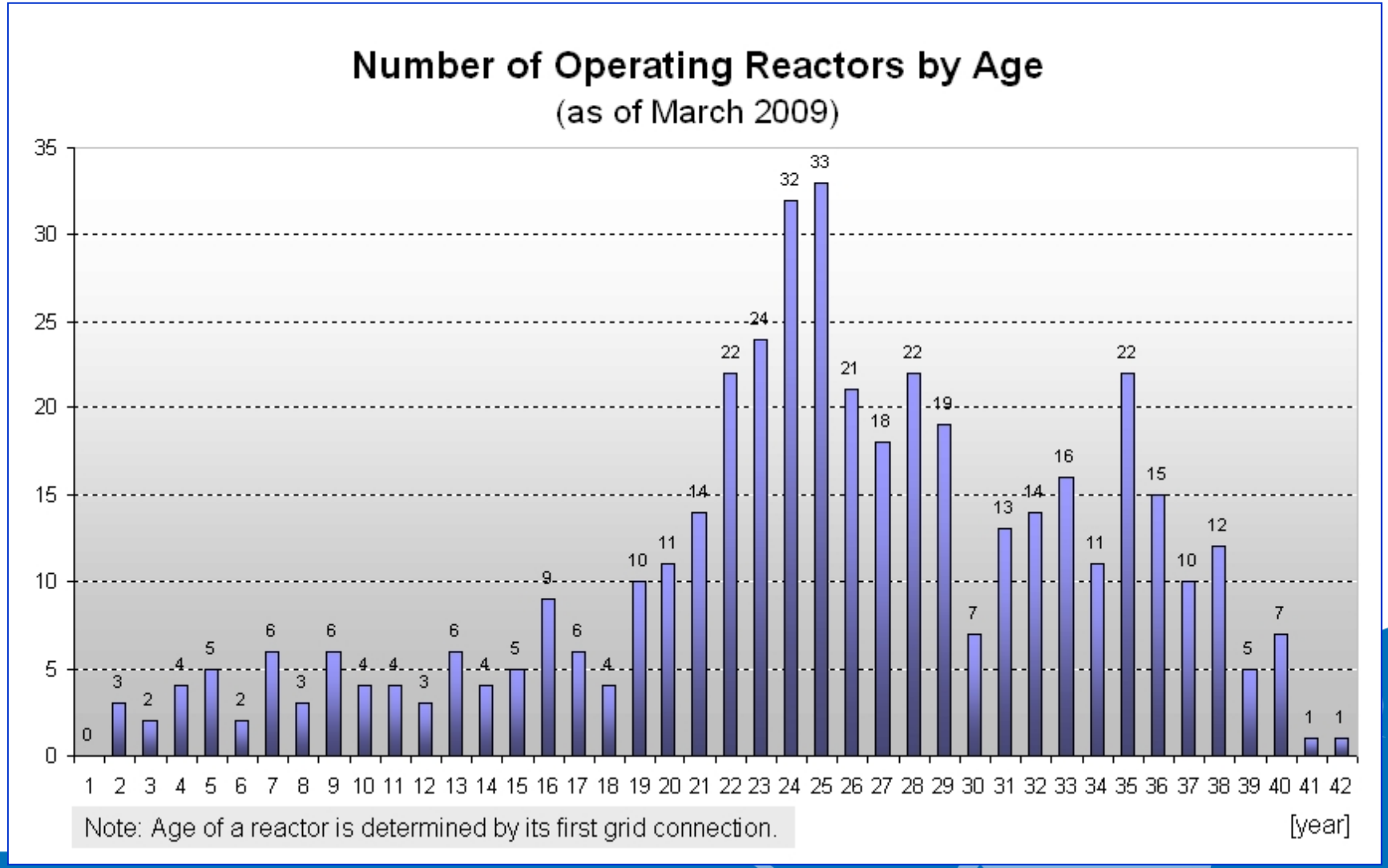

Timing is Critical

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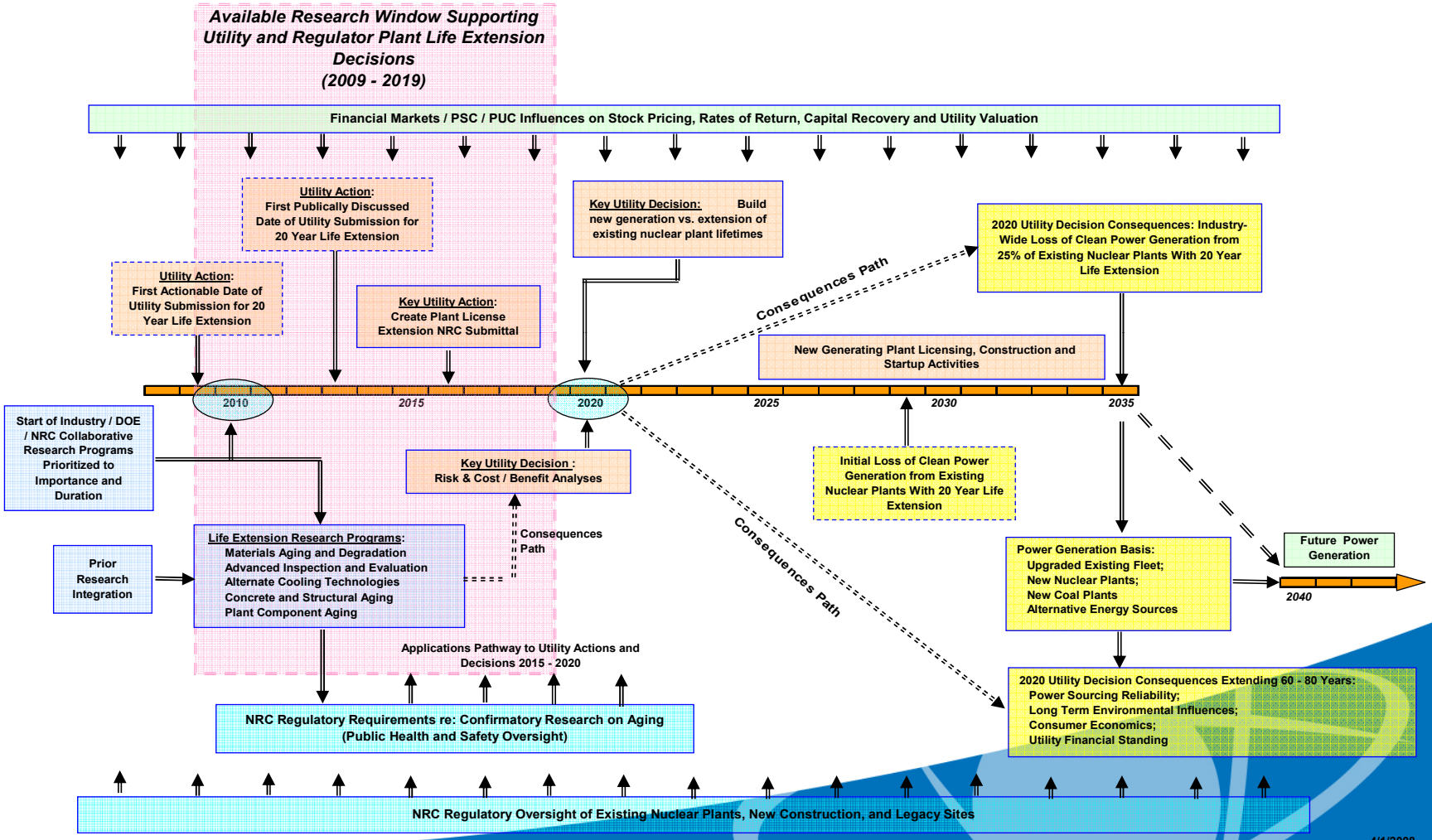

License Renewal Status

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- Initial Renewed Licenses (i.e., 40 – 60 Years of Operation) Issued for 59 Units at 31 Sites
  - Reviewing applications for 18 units at 13 sites
  - Expects submittal of 11 applications for 14 units through fiscal year 2010
- Industry Expected to Submit Subsequent Renewal Applications (i.e., 60 – 80 Years of Operation) Starting in 2013-2015
  - In order to support regulatory decisions, research is needed to determine what impacts aging will have on NPPs in the second, and subsequent, renewal period.

Materials Degradation

- Extending the life of any reactor will require comparing the known modes of materials degradation with the expected service life to identify possible problems
- Materials are a common problem/concern in existing reactors/nuclear facilities
  - Materials degradation can lead to increased maintenance, increased downtime, and increased risk
- Understanding the long-term behavior of materials in a nuclear reactor is critical for safe, reliable, reactor operation

Aging Effects for Existing NPPs

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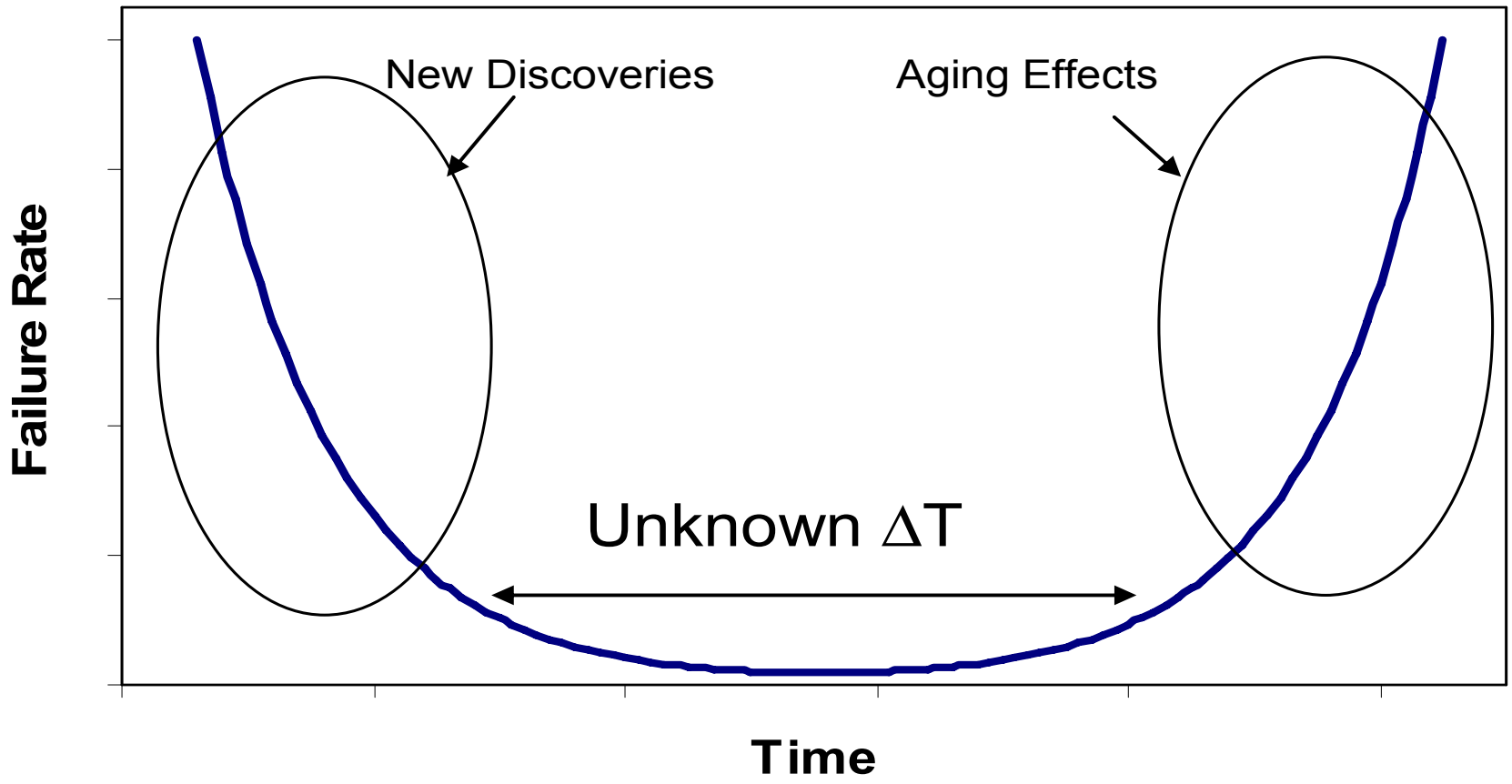
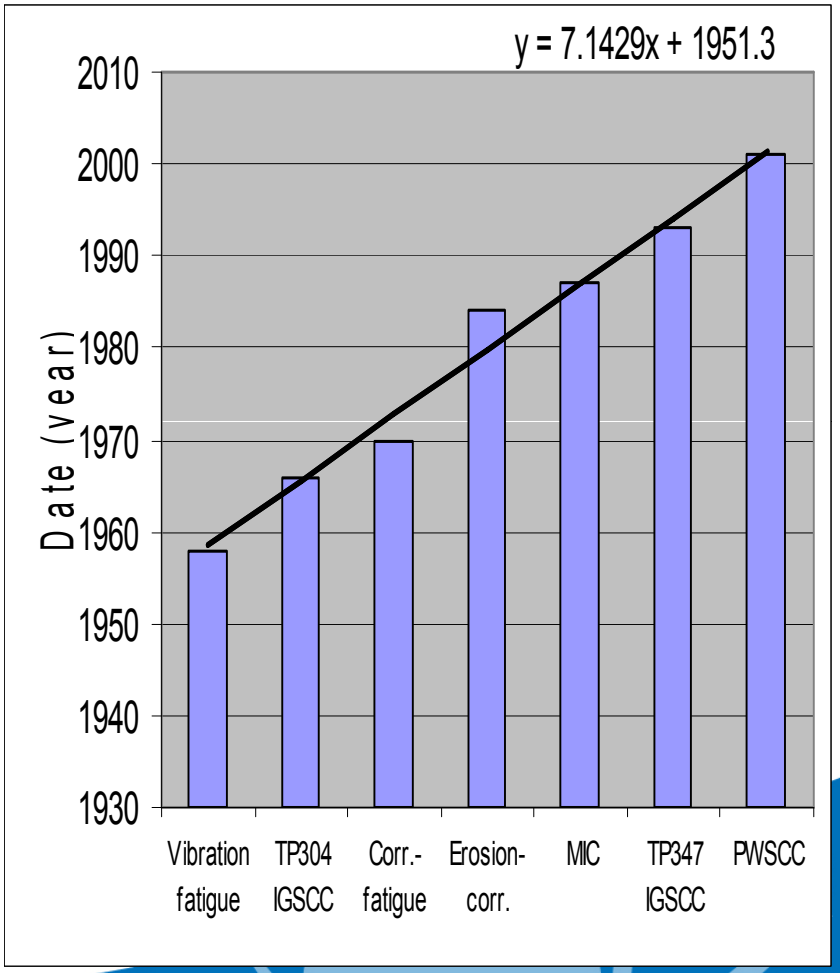
"Bathtub" Curve



Materials Degradation History

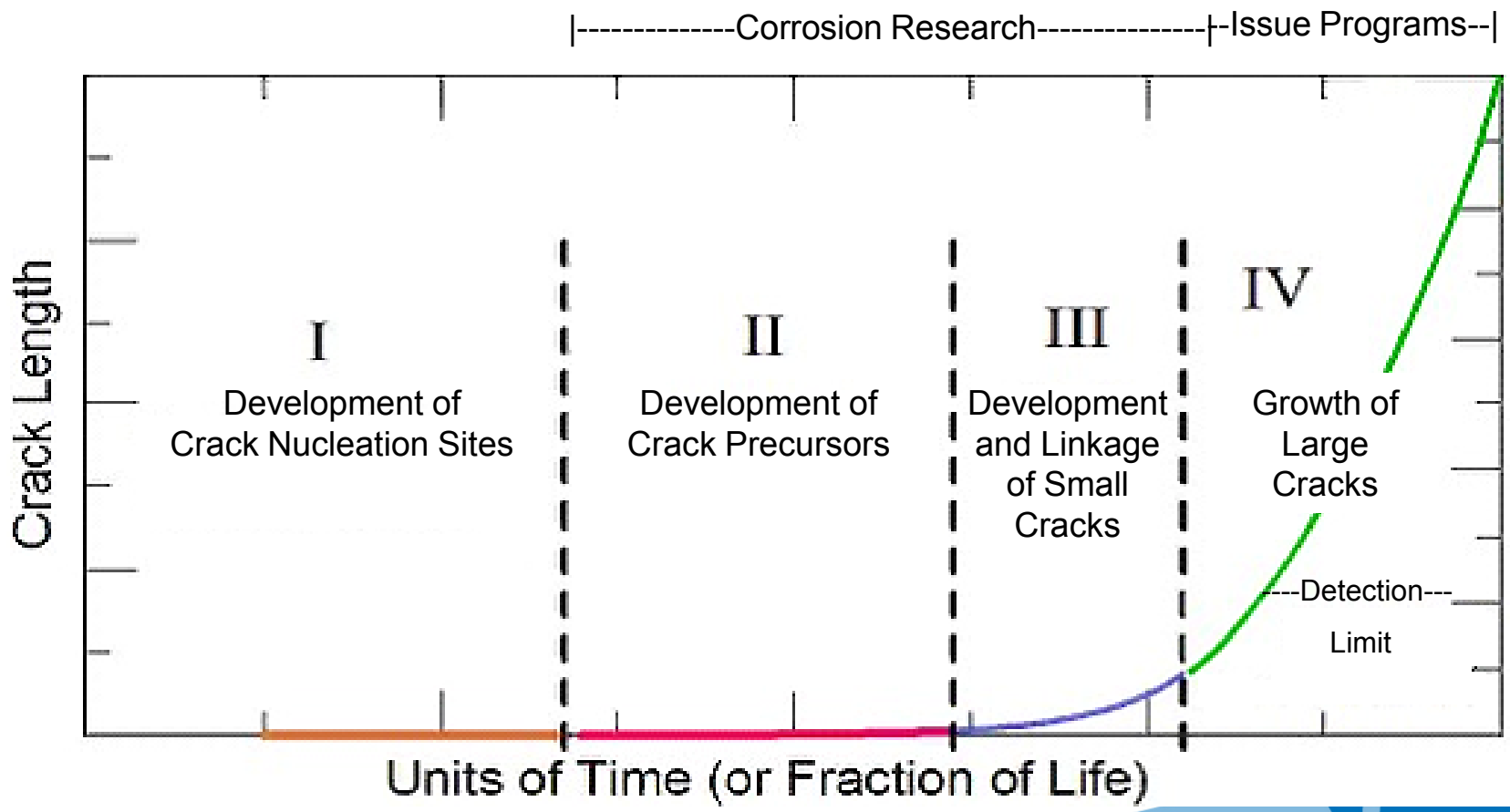
- 1958 - Vibration Fatigue
- 1966 - IGSCC in 304 SS
- 1970 - Corrosion Fatigue
- 1984 - Erosion Corrosion
- 1987 - Microbial-Induced Corrosion
- 1993 - IGSCC in TP347 Stainless Steel
- 2001 - PWSCC
- ?????



Expanded PMDA

- NRC Developed NUREG/CR-6923, "Expert Panel Report on Proactive Materials Degradation Assessment"
  - Published February 2007
  - Scope encompassed passive components in primary, secondary and some tertiary systems of BWRs and PWRs, the failure of which could lead to a release of radioactivity or affect functionality of safety systems
- NRC updating and expanding PMDA to capture operating period beyond 60 years and to expand scope
  - EMDA will ascertain gaps in present level of understanding of materials degradation during subsequent license renewal periods

Crack Propagation



Aging R&D Areas

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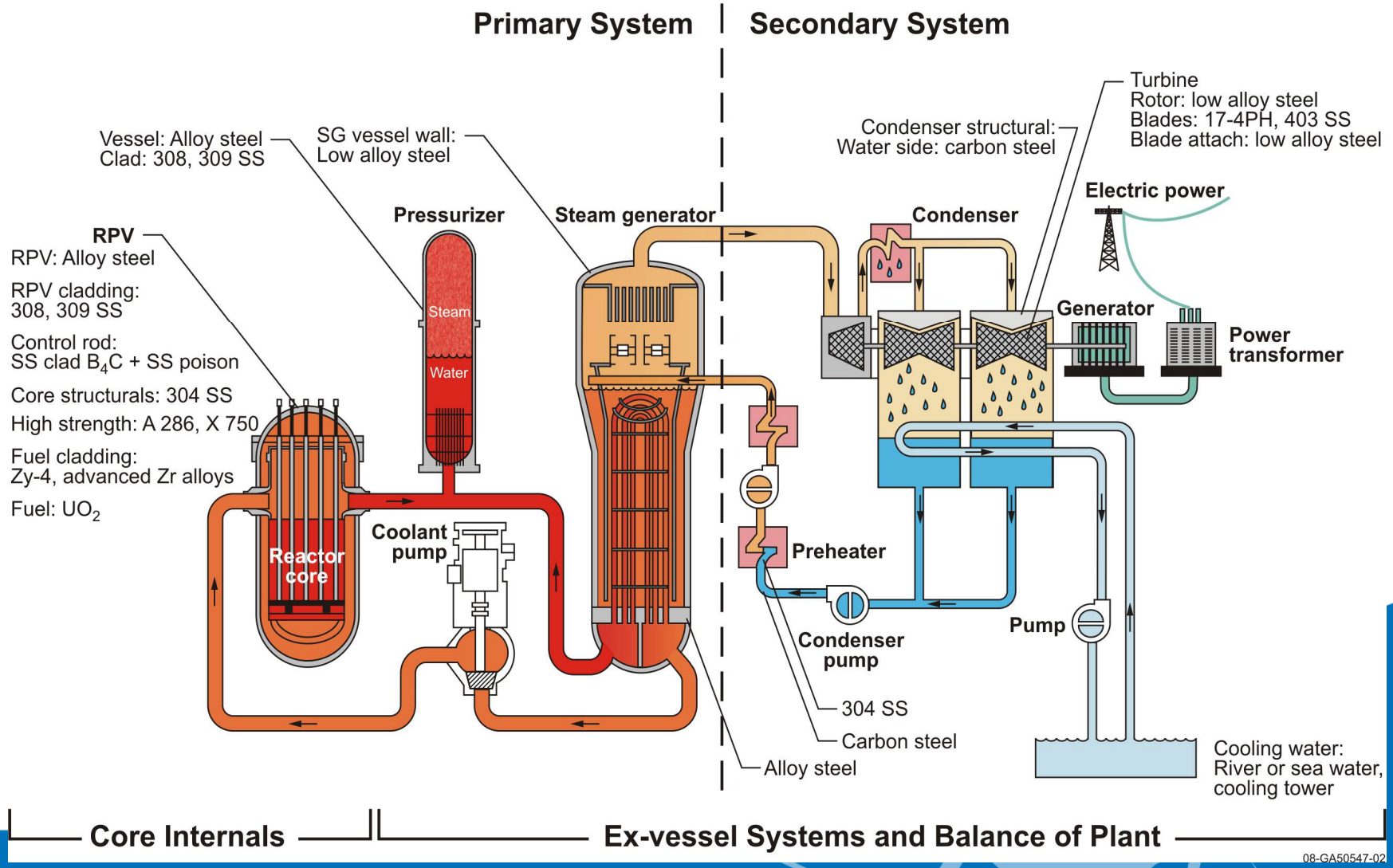

Areas to Consider

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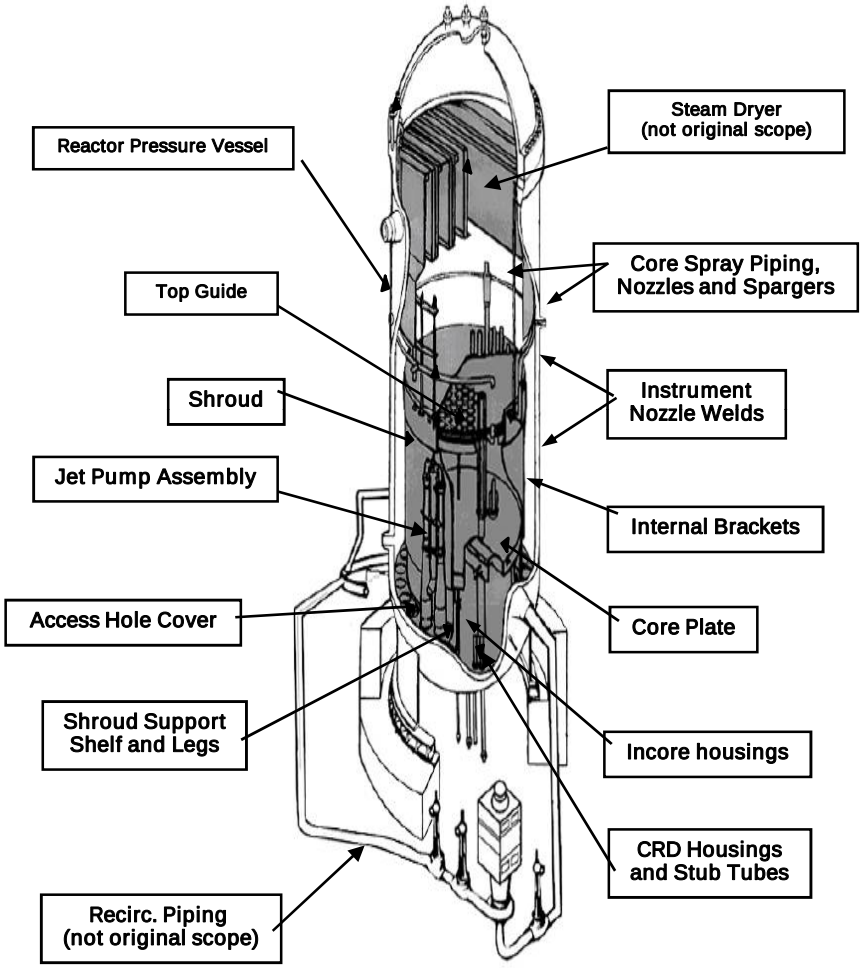

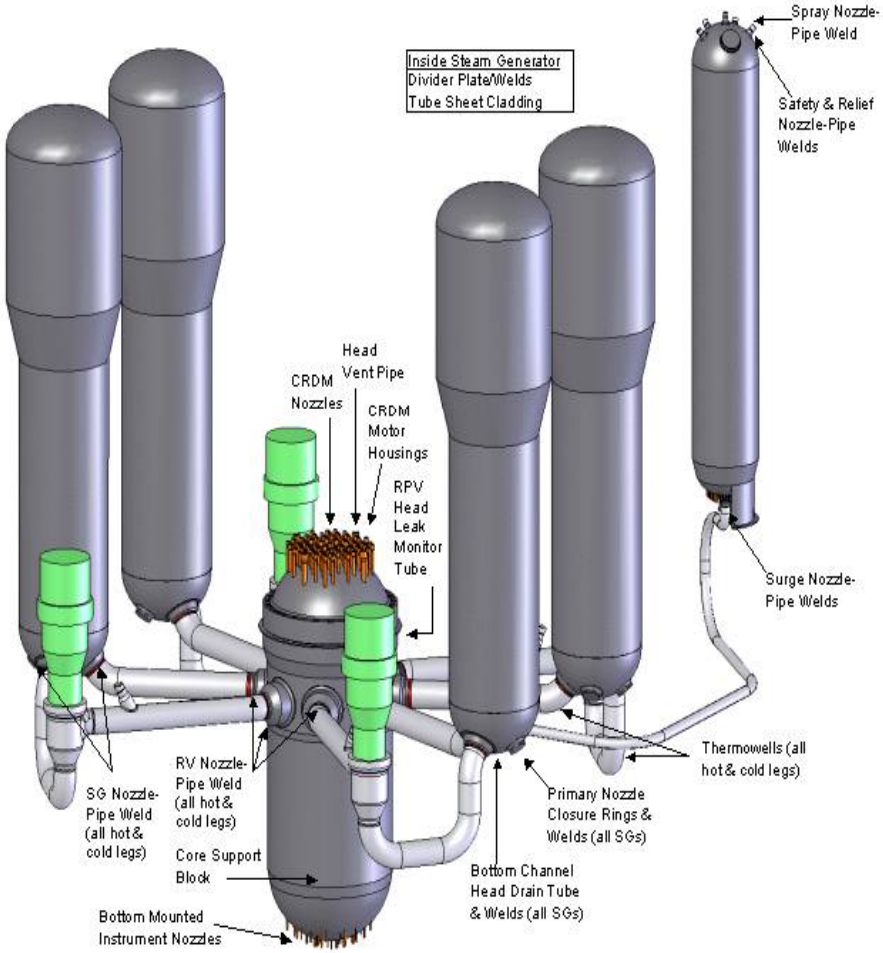

NRC's Aging Management Research

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- NRC research into potential technical issues that may challenge long-term safe operation
- Challenges include:
  - Reactor vessel and internals
  - Electric cable insulation
  - Buried/submerged structures
  - Concrete exposed to high temperature and radiation

NRC Aging Management Research

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- Information Tool Knowledge Capture & Utilization
- Identify Degradation Scenarios Not Addressed in NUREG-1801, “Current Generic Aging Lessons Learned (GALL) Report”
- Identify Inspection and Monitoring Programs and Associated Requirements for Highly Likely Degradation Scenarios

NRC Aging Management Research

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- Develop a Comprehensive Electronic Information of Inspection Results Recommended by NUREG-1801 and Plant-Specific Aging Management Programs (AMPs) Committed To By Licensees In Their Applications For License Renewal.

- Develop Domestic and International Partnerships to Share Expertise, Capabilities and Resources Related To Aging Management Research

International Forum for Reactor Aging Management

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- IFRAM's purpose is to promote worldwide cooperation to address NPP aging management issues.
  - This cooperation will include sharing of data and specimens as well as the facilitating joint research agendas and promoting work that addresses high priority issues and concerns.
- Initial Workshop held in Seoul, S. Korea, October 2009
- Next Workshop to be held at Petten, Netherlands, May 25-28, 2010

Conclusions

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- Research is necessary to establish basis for long-term operation of existing nuclear plants beyond 60 years, and this research will:
  - Answer safety questions on aging, reliability, and long-term operability of systems, structures and components
- Industry has lead role to drive the process and identify issue resolutions
  - Ultimately, life extension is utility business decision
- NRC ensures that safety-significant issues are identified and resolved in a timely manner
  - It is **not** NRC's responsibility to resolve any potential aging issues that may impact continued safe operation of existing fleet
  - NRC seeking to collaborate with DOE, industry and international partners in an integrated, holistic program to ensure long-term safety